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Status of Ohio Peach Trees

. . . with respect to certain plant elements

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Status of

OHIO PEACH TREES

with respect to certain plant elements

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Numerous articles may be found reporting deficiencies or excesses of certain elements essential for plant growth on the basis of visual symptoms on the foliage. Despite the usefulness of this technique it possesses several serious disadvantages:

1. An experienced, highly trained worker is required to diagnose the disorder.
2. With certain essential plant elements the symptoms produced by a deficiency or an excess of one element may closely resemble those produced by a different element.
3. Diagnosis on the basis of visual symptoms is at best a qualitative rather than a quantitative indication of what is needed in the fertilizer program.
4. A plant does not pass sharply from a zone of sufficiency to a zone of excess or deficiency of a given essential element. Nutritional disorders have a detrimental effect on growth, yield, and quality in the incipient stage. Therefore, serious losses may occur before the deficiency of a given essential plant element has been diagnosed by visual symptoms.

Rapid methods for the quantitative analysis of plant tissue make it possible to determine accurately the quantity of essential elements contained within the plant and its component parts. This procedure necessitates the establishment of standards by which these data may be evaluated. The authors believe that the first step in establishing such stand-

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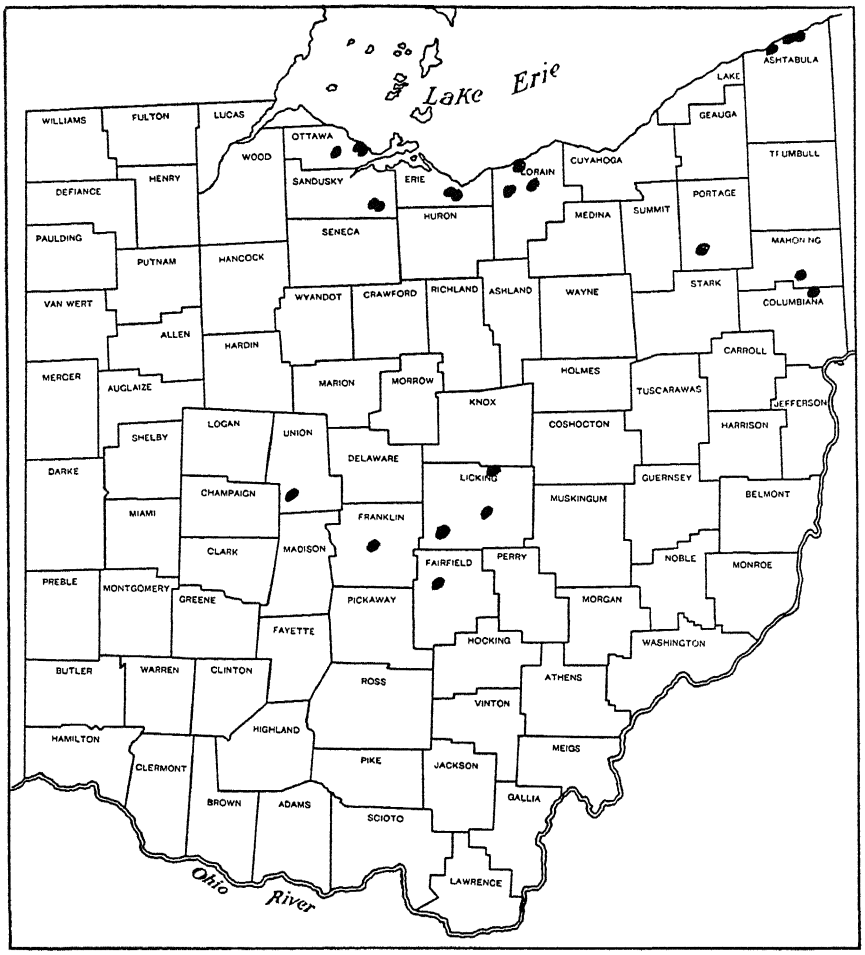

Fig. 1.—Location of orchards from which foliage samples were taken in a survey of the essential plant element status of Ohio peach trees.

ards can be accomplished by a survey type of program. Under this program a number of representative commercial orchards, whose fertilizer and cultural program can be ascertained, are sampled and analysis of these samples performed. Such a project has been previously reported for Ohio apple trees (2, 3). It is the purpose of this circular to report similarly obtained data for the Halehaven and Elberta varieties of the peach.

METHODS

A total of 22 commercial orchards were utilized in this study. They were located in 12 different counties representing the peach growing sections of central, northern and northeastern Ohio. Approximate locations are shown in Figure 1.

Foliage samples from bearing trees of the Halehaven and Elberta varieties growing in these orchards were collected between July 16 and 29, 1948. Twenty-five leaves were selected at random from medium positions and current season's growth (shoots) from each of 4 trees to make a 100 leaf composite sample. The four trees making up each sampling unit were located in close proximity to one another and were of the same age and of similar size and vigor. At the time of sampling records were made as to 1948 fertilizer applications by the growers. These will be referred to subsequently as 1948 fertilizer applications by the grower. With the exception of visual symptoms of nitrogen deficiency, none of the trees included in this survey showed any indications of nutritional disorders.

Leaf samples were returned to the laboratory at Wooster within 48 hours after removal from the trees. When any spray residue was evident it was removed from the leaves by wiping with a damp cheesecloth. The samples were dried to a constant weight at 70 degrees C in a forced draft oven, ground to pass the 40 mesh sieve in a Wiley mill and stored in tightly capped glass bottles prior to analysis.

Total nitrogen was determined by a modification of the Kjeldahl-Gunning method using selenium in the digestion catalyst mixture to reduce the time necessary for digestion. Potassium was determined using a Perkin-Elmer Model 18 flame photometer. Total calcium, magnesium and manganese were determined by the semi-micro methods of Peech (5). Iron was determined using the orthophenanthroline colorimetric method as outlined in A.O.A.C. (1). Boron was determined by the method of Berger and Truog using the quinalizarin-sulfuric acid reagent (4).

RESULTS AND DISCUSSION

Orchards included represent some variation in climate and considerable variation in soil type. Fertilizer practices varied from orchards which received no fertilizer to those which received complete fertilizers in combination with mulch. It was anticipated, that there would be wide ranges in leaf concentrations of the various elements. This proved to be the case with nitrogen values ranging from 1.87 to 4.04 percent of the dry weight, potassium from 0.66 to 3.10 percent of the dry weight,

and other elements showing similar variation. In a few instances leaf samples were obtained at a given orchard from trees receiving different fertilizer treatments. In such cases direct comparisons of foliage concentrations of the various elements resulting from different fertilizer practice may be made.

The chemical data for nitrogen and potassium in Halehaven peach leaves presented in Table 1 are separated according to 1948 fertilizer application by the grower, as follows: 1) normal nitrogen fertilization only, 2) no nitrogen fertilizer applied, and 3) application of a fertilizer containing nitrogen, phosphorous and potassium. Because of differences in soils, rainfall, degree of pruning, extent of crop, past fertilizer practices and many other factors these data are extremely variable. They indicate several general trends. Nitrogen, either alone or in combination with phosphorous and potassium, resulted in higher foliage concentrations

TABLE 1.—Nitrogen and Potassium Content of Halehaven Peach Leaves from Trees Receiving Various Fertilizer Materials

Sample No	1948 Fertilizer Applications Made by Grower					
	Normal application of nitrogen*		No N -1948		Application of nitrogen, phosphorous and potassium fertilizer	
	Percent of the dry weight					
	N	K	N	K	N	K
73	2.62	1.88				
77	3.03	1.90				
80	2.90	1.87				
88	3.14	1.16				
161	3.48	2.35				
166	4.04	1.33				
177	3.30	2.94				
190	3.29	0.66				
196	2.88	2.11				
206	3.68	0.95				
176			2.97	3.10		
178			3.23	3.06		
182			3.29	3.00		
193			1.87	2.06		
203			2.06	0.97		
164					3.38	2.85
168					3.46	0.67
172					3.00	1.53
192					3.21	1.95
Total	32.36	17.15	13.42	12.19	13.05	7.00
Average	3.24	1.71	2.68	2.44	3.26	1.75

*Normal application of nitrogen considered as ¼ lb $NaNO_3$ per year of tree age or its equivalent in other nitrogen carriers

of nitrogen and lower foliage concentrations of potassium with the Halehaven variety than where no nitrogen was supplied. This is shown not only by overall average values but by samples from individual locations as well. Samples 176 and 177 as well as 192 and 193 were paired samples which came from the same orchard but received different fertilizer treatment. In each case, they bear out the observation made on the basis of the overall averages.

All of the Elberta trees included in this study were fertilized, either with nitrogen alone or in combination with phosphorous and potassium. Differences in foliage nitrogen and potassium resulting from these two treatments are of doubtful significance (Table 2) considering the limited number of trees sampled and the variation between samples from a given fertilizer treatment. The data from both the Halehaven and Elberta varieties with respect to nitrogen and potassium show that the use of complete fertilizers in orchards included in this study was of doubtful value in raising the nitrogen and potassium status of the trees above what could be expected from the use of nitrogen alone.

TABLE 2.—Nitrogen and Potassium Content of Elberta Peach Leaves from Trees Receiving Various Fertilizer Materials

Sample No.	1948 Fertilizer Application by Grower			
	Normal application of nitrogen*		Application of nitrogen, phosphorous and potassium fertilizer	
	Percent of the dry weight			
	N	K	N	K
72	2.13	1.84		
76	2.10	2.24		
81	2.80	1.73		
89	2.38	1.27		
94	2.32	1.73		
162	3.22	2.71		
184	2.79	3.01		
276	2.29	2.28		
277	2.59	2.22		
278	2.54	2.28		
163			2.81	2.99
170			2.91	1.68
173			2.60	2.70
Total	25.16	21.31	8.32	7.37
Average	2.52	2.13	2.77	2.46

*Normal application of nitrogen considered as ¼ lb. $NaNO_3$ per year of tree age or its equivalent in other nitrogen carriers.

Over 10 percent of the orchards included in the survey produced foliage containing less than 1 percent potassium (Table 1, Samples 168, 190, 203 and 206). On the basis of previous experimental work, potassium foliage concentrations of this order represent potassium deficiency. This condition occurred in orchards which had received no fertilizer in 1948, nitrogen alone, and nitrogen in combination with phosphorous and potassium. None of the trees showed visual symptoms of potassium deficiency on the foliage. This evidence demonstrates that the deficiency in its incipient stages can be diagnosed only by the use of chemical analysis of the foliage.

The potassium status of such orchards can be raised by applications of from 2 to 4 pounds per tree of muriate or sulfate of potash. The quantity of potassium supplied in a normal application of a complete fertilizer is insufficient to raise such trees from the deficiency level. It should be noted also that in such instances applications of nitrogenous fertilizers are likely to further suppress accumulation of potassium in the foliage and thus tend to aggreviate the already existing potassium deficiency condition.

Data summarizing the foliage contents of nitrogen and six mineral elements are presented in lines 1 and 3 of Table 3. These data were compiled using samples taken from trees which received nitrogen either alone or in combination with phosphorous and potassium. These trees showed no visual nutritional deficiency symptoms and had made in most cases satisfactory shoot growth. The authors are of the opinion that these data are representative of Halehaven and Elberta peach trees in a satisfactory state of vigor. The *mean values* of the 14 Halehaven samples and the 13 Elberta samples are therefore considered as satisfactory foliage concentrations for the seven essential plant elements determined for these two varieties. They are by no means set forth as optimum values. Such optimum values can be established only by careful experimental work involving the application of different kinds and amounts of fertilizers and correlating foliage analysis with growth, yield and quality.

Values given in Table 3 may be used as a yardstick with which may be judged the nutritional status of these two varieties which appear to be suffering from nutritional disorders. Not only should the mean values be applied in such cases, but the ranges of the different elements must be considered as well. If, for example, a Halehaven foliage sample is found by analysis to contain 2.70 percent nitrogen it would be classified as within a range where response to additional nitrogen would be questionable. If, however, a sample of the same variety contained 1.80 to 2.00

TABLE 3.—A summary of the foliage analysis data for Halehaven and Elberta peach trees showing the range and mean values for seven essential plant elements and the concentrations of nutrients obtained when minor elements were added to a complete fertilizer containing nitrogen, phosphorous, and potassium.

Treatment	Percent of the dry weight				PPM—Dry weight basis		
	Nitrogen	Calcium	Magnesium	Potassium	Boron	Manganese	Iron
Halehaven							
All samples receiving N alone or in combination with P and K							
Range	2.62–4.04	0.83–2.66	0.170–0.754	0.66–2.94	19–34	40–281	98–479
(Mean)	(3.01)	(1.80)	(0.413)	(1.72)	(29.6)	(105)	(185)
Mean of two samples from 8 trees receiving N, P and K fertilizer containing minor elements	2.72	2.19	0.399	1.91	33	52	230
Elberta							
All samples receiving N alone or in combination with P and K							
Range	2.10–3.22	0.85–3.27	0.177–0.657	1.27–3.01	21–35	40–251	114–253
(Mean)	(2.57)	(2.36)	(0.442)	(2.21)	(30)	(89)	(180)
One sample from four trees receiving N, P and K fertilizer containing minor elements	2.81	0.85	0.245	2.99	33	46	124

percent nitrogen, response to additional nitrogen might reasonably be anticipated in terms of increased growth, leaf color, yield and fruit size. This last point brings up the matter of varietal differences in relation to fertilizer utilization. The data show that the Halehaven variety has a higher foliage content of nitrogen and a lower foliage content of calcium and potassium than the Elberta variety. Differences in varietal composition of magnesium, boron, iron, and manganese are not apparent, however.

A number of growers have shown considerable interest in the use of complete fertilizers "fortified" with minor elements. Of the orchards included in this work, two Halehaven growers and one Elberta grower had made an application of fertilizers of this type. The results in terms of foliage content of several essential plant elements are shown in lines 2 and 4 of Table 3. The boron and iron content of Halehaven peach leaves was raised only slightly by the use of this material. Manganese was much lower following the use of this fertilizer than the mean value obtained from all samples. With the Elberta variety, the boron content was raised only slightly while iron and manganese were lower than the average values for all samples. On the basis of these data the application of fertilizers fortified with minor elements were of doubtful value in raising the minor-element status of peach trees in the season immediately following their application.

SUMMARY

Composite foliage samples of Halehaven and Elberta peach trees from 22 commercial orchards taken in late July 1948 were analyzed for total quantities of seven essential plant elements. Wide variations were found in foliage concentration of all of the elements determined. This was attributed largely to the extremes in soils, rainfall, past fertilizer practice, degree of pruning, size of crop, and other factors encountered in sampling over a large area.

With the Halehaven variety the use of nitrogen fertilizer was associated with higher leaf nitrogen and lower leaf potassium than when no nitrogen was applied. Since all the Elberta trees sampled received nitrogen in some form a comparable comparison cannot be drawn with this variety.

The use of complete fertilizers were of doubtful value in raising the nitrogen or potassium status of the trees above that obtained with the use of nitrogen alone. Over 10 percent of the orchards surveyed produced foliage containing deficiency concentrations of potassium. The amount

of potash supplied in a normal application of a complete fertilizer is insufficient to raise such trees from the deficiency level. This can be done only with moderately heavy applications of potassium fertilizers such as muriate or sulfate of potash.

The use of complete fertilizers containing minor elements was of doubtful value in raising the minor element status of the peach trees included in this work. The possibility remains that such materials may be effective over a longer period of time. There was no indication, however, that any of the trees sampled in this survey exhibited the need for additional boron, iron, or manganese.

The Halehaven variety exhibited a higher foliage content of nitrogen and a lower content of calcium and potassium than the Elberta variety.

The mean foliage concentrations of the seven elements determined are proposed as useful values in diagnosing the nutrient status of Halehaven and Elberta peach trees which appear to be suffering from nutritional disorders.

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